CONTRACT
AF 61 (052) - 839

1 JANUARY, 1967

SCIENTIFIC REPORT

REACTIONS TO STRESS

DR. S. KUGELMASS

THE HEBREW UNIVERSITY
DEPARTMENT OF PSYCHOLOGY
JERUSALEM, ISRAEL

The Research reported in this document has been sponsored by the Air Force Office of Scientific Research, through the European Office, Aerospace Research, United States Air Force

CONTRACT
AF 61 (052) - 839

1 JANUARY, 1967

SCIENTIFIC REPORT

REACTIONS TO STRESS

DR. S. KUGELMASS

THE HEBREW UNIVERSITY
DEPARTMENT OF PSYCHOLOGY
JERUSALEM, ISRAEL

The Research reported in this document has been sponsored by the Air Force Office of Scientific Research, through the European Office, Aerospace Research, United States Air Force

TABLE OF CONTENTS

PREFACE

The research effort to be described may be viewed as a continuation of our study supported by AF EOAR grant 63-61. Both Israel Lieblich and Shlomo Breznitz agreed to collaborate with the principle investigator in a program of research that might be broadly called reactions to stress. While there was continued coordination and cooperation during all of the project, it appeared useful for Dr. Breznitz to focus most of his energies on the development of the worrying scale and its accompanying stress experiments. Mr. Lieblich's efforts were concentrated on the experiments related to the detection of information through psychophysiological means which included his Ph.D. thesis work. Michal Kahel, Baruch Frishberg, and Gershon Ben Shachar served as research assistants during the entire period of the project. Others who participated in the project include: Ben-Ari Mordechai, Bergman Tamar, Bergman Ze'ev, Carp Anath, Dothan Tamar, Gopher Esther, Kalinkowitsky Dan, Kleeman Ronith, Kneler Margalith, May Elisheva, Tamir Nomi, Zuckerman Miron.

The research program was markedly enriched through opportunities provided by the cooperation of a number of individuals in relevant institutions. Close contact with the Israeli Police was maintained through officers Shur, Kaplan, Ben-Ishai and Opptowsky. Not only did this provide us with means to obtain appropriate samples of experimental subjects, but a continuous joint seminar on problems of Police polygraph operation allowed us to develop better understanding of issues related to practical field work in this area. It is our hope that we have been able to supply some return in raising issues more closely related to theory and experiment.

We would like to express our appreciation to Professor Groun and the rest of the staff of Hadassah's department of Internal Medicine for their help in the testing and record analysis of patients who answered our questionnaire. Similar thanks are due to Mr. A. Segal and Dr. Plesenbach of Arzah Rehabilitation Center. We are much obliged to Mrs. Eser and Mrs. Swidowsky for their help in obtaining the important cooperation of the Jerusalem WIZO baby home for the research project on young children.

I. INTRODUCTION

There has been a long and continuous interest in this laboratory in the general area of reactions to stress. Several years ago our attention was brought to questions raised about the usefulness of the G.S.R. channel in detection work under actual field conditions (Inbau & Reid, 1953). This appeared to be of special interest because of the excellent results obtained through this channel in laboratory experiments. A review of the limited relevant scientific literature (Woodworth & Schlosberg, 1956) suggested the possibility that short term G.S.R. reactivity might be influenced by the longer term level of stress involved in the particular setting. In addition to being of practical importance to the field application of polygraph detection, this possibility would be of basic methodological importance to experimental psychology and psychophysiology where the GSR channel has been of such extensive use. An experiment was thus attempted in which it was hoped to combine laboratory control over relevant variables with an approximation of a real life stress situation. A full description of the experiment was reported in 1963 (Technical Report, AF EOAR grant 63-61).

The findings of that study suggested that the GSR detection rate under the experimental stress was essentially similar to that found in non-stressful laboratory conditions, and far superior to the other index of heart rate change examined. An analysis of the relevant reactivity showed a strong relationship to basic conductance, and surprisingly the reactivity appeared to be systematically related to the ethnic origin of the subjects. A relatively high number of subjects who originated in countries near or forming the Mediterranean Sea basin showed little or no relevant GSR reactivity.

Consideration of the above findings gave rise to the studies to be presented in this report. The first study to be reported was an attempt to explore the possibility that something other than the stress level within the actual police procedure might account for the poor results reported by the field operators in their use of GSR. Subjects for this experiment were drawn from the Police Force in order to provide an appropriate sample from which to check the findings related to ethnic background observed previously. In addition to finding the appearance of non-reactivity in certain of the records, careful analysis turned up another pattern of reaction that was present during the"interference effect" of the blood pressure cuff. This pattern of relatively high "noise" in the GSR channel is more difficult to describe and conceptualize, but would appear to be of theoretical interest. It probably is of even greater practical significance in lie detection than the straight "non-reactivity". It may be useful to formulate the reduction of detection efficiency as a resultant of a shift toward a lower signal to noise ratio.

Chapter III is devoted to an analysis of the data collected in this new study on the "blood pressure interference" effect which follows up the finding of the relationship between relevant GSR reactivity and ethnic origin. The initial finding was confirmed, and further analysis suggested that another (possibly related) variable - the number of years of schooling - was of significant influence in both of these samples. It would appear useful to relate our findings to a number of recent reports dealing with differences between white and negro subjects on a number of GSR indices. (Bernstein, 1965) (Johnson and Corah, 1963),(Johnson and Landon, 1965) and

(Sternbach, 1965). Up to now little insight has been forthcoming regarding possible mechanisms. In the present research our lead related to the "Law of Initial Values" did not receive support in the second experiment. Further thought must be given to the present findings showing the influence of years of education and ethnic background, but having an impact on relevant GSR reactivity that does not relate systematically to performance on a standard intelligence test.

Analysis of the results of the first experiment suggested that we had not been able to generate a level of stress equal to that encountered by the person involved in a real criminal interrogation situation. The experiment described in chapter IV was arranged in cooperation with the Israeli Police so as to overcome this limitation. The results of the experimental examinations carried out in the Police lab using the usual field polygraph equipment suggest that the GSR detection rate (at least within the card test paradigm) is reasonably constant over the range of stress relevant to lie detection procedure. Negative results were once more obtained for the heart rate index, but surprisingly good results appeared when using the blood pressure curve index. Only a slight cuff interference effect was noted in this experiment. Both of these issues related to the simultaneous use of the GSR and blood pressure channels deserve more systematic attention.

During our efforts to evaluate the influence of the effect of general stress level we started to consider the theoretical basis underlying the attempts to obtain detection of information through psychophysiological channels. It soon became apparent that there was a relative paucity of

specific theoretical formulation that might serve as a guide for sharply defined research. One issue that seemed to be worthy of clarification was the exact role of lying behavior per se. The experiment in chapter V was an attempt to evaluate that behavior. The results leave little doubt that further experimental work is necessary to delineate the place of the act of lying in any theory of the detection of deception.

The results of the experiments reported in chapter VI should be regarded with caution since they are pilot studies at best. Nevertheless they do suggest that more attention should be directed to several aspects of the stimulus presentation.

Chapter VII describes an attempt to move toward a theory of short term physiological reactivity which might ultimately serve as a theoretical basis for detection. An experimental design was invoked to test whether variables known to influence short term attention would in proper combination show up in systematic physiological reactivity. The results are certainly promising, and will require further extension. They indicate that an experimental attack on the basis of contrast underlying the signal to noise ratio model of detection should consider variables related to attention and concentration. Several of the findings would appear to be of interest to aspects of developmental psychology. It is of particular interest that the variables found to be of importance in "non-reactivity" of adults, (ethnic origin and years of education) were found to be of significant influence in the little children.

Chapter VIII summarizes an attempt to develop a new questionnaire technique in order to get at long term individual differences which might

be of importance for the better understanding of short term responsivity. The MAS has had considerable success in doing just that in several areas of psychology. On the other hand certain clear weaknesses of the MAS seemed to suggest that profitable investment of energy could be made in an improved technique. The results of the first effort in this direction are clearly promising, although it is apparent that the task is not an easy one. While the new technique (WS) still must await a more thorough examination of its validity, it seems as though it has overcome the problem of SD or social desirability. In addition it has been possible to show that performance on different parts of the test were significantly related to the behavior (performance and physiological activation) of subjects in an experimental stress situation. A couple of suggestive leads have even been uncovered that relate directly to the detection of information type experiment.

It is expected that the research efforts of the group will continue along lines described above.

II. THE INFLUENCE OF BLOOD PRESSURE CUFF APPLICATION ON THE EFFICIENCY OF GSR DETECTION

Given the previous finding that considerable stress need not interfere with GSR detection attention was drawn to other differences between laboratory procedure and the methods employed by the police in actual criminal interrogation. The standard polygraph used by police and security agencies contains three channels. These three channels permit the simultaneous recording of : (1) blood pressure changes, (2) changes in respiration rate and amplitude, and (3) changes in the conductance of the skin. The procedure for measuring blood pressure includes the use of a cuff placed around the upper arm of the subject. This cuff is inflated to a pressure somewhat above the diastolic blood pressure of the subject, and this condition is maintained during the interrogation. The usual pressure used is about 90 mm. Hg. and this pressure may be held as long as two and a half minutes depending, of course, on the number of questions to be used in a particular portion of the investigation. This means of measuring blood pressure which is common to police work is rarely used in the laboratory studies for reasons described by Lacey (1964). It seemed possible, therefore, that the use of this blood pressure measurement system might interfere with the measurement of skin conductance, and thus lead to the poor results obtained from this channel, observed by operators in the field.

METHOD

Forty Police cadets were obtained as subjects from the Israel Police Force school in Jerusalem. The subjects were told that they were being used to test the efficiency of a lie detector to be used in the department of Psychology. All of the testing was carried out in an air conditioned laboratory where a temperature of 21°C. was maintained. The subject was seated at a table facing a blank wall. After a brief introduction stainless steel electrodes were attached to the volar side of the index and fourth finger of the left hand using Sanborn electrode paste to ensure proper contact and minimize polarization effects during the measurement of GSR. A constant current GSR apparatus was used as described in Kugelmass(1963).

Each subject was tested under two conditions thus serving as his own control in a random balanced design to control for order effects. In the GSR and cuff condition an ordinary HAKO Sphygmomanometer cuff was wrapped around the upper part of the right arm of the subject and inflated to a pressure of 80 mm. Hg. The pressure was maintained for the 90 seconds of this condition. No blood pressure cuff was used during the GSR condition. In both conditions the subject was requested to choose a card from a pile on the table (2,3,5,8,9, and 10 of diamonds), to write down the number of this card on a form placed before him, and to answer "no" to the

subsequent questions "did you choose card number ...?" In both sessions the sequence of numbers asked in a randomized order provided that each number appeared twice during the ninety seconds of questioning. The first number asked in each condition was number one which served as a buffer against initial startle. Three minutes of basal skin resistance during rest was recorded prior to each of the two conditions. The basic skin resistance in ohms thus obtained was transformed to units of conductance.

RESULTS

Analysis of the data obtained during each of the two conditions was carried out by determining the card number yielding the highest mean ohm change, and comparing this result with the numbers previously recorded by the subject himself. The number of "hits" and "misses" in each condition is presented in table 1.

Table 1. The Number of Cards Correctly and Incorrectly Detected in the GSR and Cuff Condition, and the GSR Condition.

Condition	Result of detection	
	Correct	Incorrect
GSR and Cuff	11	29
GSR	20	20

Using a Poisson approximation to an assumed binomial model (40, 1/6) it was found that the number of correct detections in the GSR and Cuff condition is not significantly different from chance at the .05 level. The number of correct detections in the GSR condition, on the other hand, is significantly greater than chance ($\alpha < .001$). A χ^2 test of dependent proportions demonstrates a change in efficiency between the two conditions that is significant ($\alpha < .05$). A closer look at the individual data reveals that all but three of the persons detected in the Cuff plus GSR were among those detected in the GSR condition. This would meet the 90% criterion for a Guttman scale,(Guttman et al 1949).

DISCUSSION

One possible explanation of the lower GSR detection efficiency is that the cuff manipulation raises the basic conductance of the skin, and leads to a reduction in specific stimulus related GSRs as predicted from the "Law of Initial Values". Such an explanation is unlikely in this case since the mean and standard deviation of the conductance values were practically identical in both experimental conditions ($\bar{x}$ = 17.5 and s = 2.5 micromhos). The values of both of these conditions were significantly different than the values obtained during the pre-experimental rest periods ($\bar{x}$ = 15.2 and s = 2.7 micromhos, $\alpha < .01$).

Further analysis indicates that the difference between the mean GSR amplitudes to the "relevant" cards and to the "non-relevant" cards in the GSR condition ($\bar{x}$ = 475.5, s = 660.5 ohms) is significantly different. ($\alpha < .05$) from the"relevant - non-relevant" difference under the GSR and Cuff condition ($\bar{x}$ = 178.0, s = 475.5 ohms). The introduction of the blood pressure cuff thus tends to reduce the <u>contrast</u> between responses to the "relevant" and "non-relevant" cards rather than show effects due to a shift in the base-line conductance. One might formulate this as a reduction in efficiency due to shift toward a lower signal to noise ratio. It is only possible to speculate on the mechanism by which the inflated cuff reduces the GSR efficiency since so many variables might be involved, eg. homeostatic balancing mechanisms, pain, attention, etc. It is clear, however, that these results should be considered by those workers using simultaneous recording in lie detection.

III. EXAMINATION OF CERTAIN BIOGRAPHICAL CORRELATES OF GSR REACTIVITY DURING EXPERIMENTAL LIE DETECTION

Our initial study (Kugelmass, 1963) indicated the possible correlation between the size of the GSR response to the relevant card (the card actually chosen by the subject), and ethnic origin. It was found that subjects originating from middle eastern countries tended to be less reactive to this "hot" card than subjects born in Europe or Israel. The tendency was present in all three conditions within the experiment, but only reached statistical significance in condition B.

The data obtained in the blood pressure cuff experiment provided an opportunity to check this observation on a new, but similar sample. An analysis was carried out in which a person was considered to be "non-reactive" when he showed a mean reduction of skin resistance of less than 1000 ohms following his answer "no" to the question about the card he had actually chosen. This analysis was applied to the data obtained during the GSR condition of the blood pressure cuff experiment which may be considered most similar in instructions to condition A of the 1963 study. Following the earlier results we make the specific hypothesis that a higher proportion of the subjects of middle eastern origin will be expected in the non-reactor category. The results of this analysis appear in table II.

Table II

The relation between ethnic origin and GSR reactivity to the "hot" card.

R = Reactor, NR = Non-Reactor.

	R	NR	
Western origin	10	6	16
Middle Eastern origin	8	16	24
	18	22	40

The chi square value obtained for table II is 3.30. ($\alpha < .05$ one tailed). It should be mentioned that the two samples differed substantially in mean level of education. Whereas the mean education level was 6.3 years with a standard deviation of 1.75, in the 1963 sample, the level of education in the later sample was 9.3 years with a standard deviation of 2.06

No relationship has been found between ethnic origin and GSR reactivity to the irrelevant cards, in either sample.

In the 1963 sample quite a strong relationship was found between ethnic origin and basic conductance. Subjects of middle eastern origin tended to show higher conductance levels than western subjects. This difference in conductance between the two ethnic groups was not found

to be replicated in the second sample (t = 0.34, 38 df). It should be stressed that no significant differences in intelligence (on a stanine scale) or in mean number of years of education were found between the two ethnic groups, in both of the samples analysed.

GSR "hot" reactivity and years of education. Although no difference in mean education level was found between the two ethnic groups it seemed advisable to correlate GSR reactivity and years of education regardless of ethnic origin.

In condition A of the 1963 sample a Pearson correlation of 0.54 was found between years of education and GSR reactivity to the "hot" card. In the second sample the correlation between these variables was 0.50. The Pearson correlations between GSR reactivity to the irrelevant cards and years of education were 0.04 and 0.01 in the 1963 and the second sample respectively. Correlations between "hot" reactivity and a measure of intelligence were 0.00 and 0.09 in the 1963 and second sample respectively.

Card detectibility and years of education. The correlation between years of education and card detectibility was 0.50 in the 1963 sample and 0.46 in the later sample.

Basic conductance and years of education. The correlations between basic skin conductance and years of education were -0.04 and -0.09 in the 1963 and second sample respectively.

DISCUSSION

The results of the above analysis may be summarized as confirming the importance of both ethnic background and years of education as variables influencing the differential GSR reactivity relevant to the card detection situation. The recent findings of GSR differences between white and negro subjects were brought to our attention. Johnson and Corah (1963) found GSR baseline differences between negro and white samples. Sternbach (1965) found GSR reactivity differences between negro and white housewives. An attempt to account for the baseline differences in terms of differential sweat gland activity by Johnson and Landon (1965) was not successful.

It appears important to mention that this differential reactivity is probably not explicable in any simple way related to possible differences in the intellectual ability of the ethnic groups. No difference in years of schooling or measured intelligence was found between the two groups. A possible explanation raised after the difference in baseline conduction was found in the first sample, was derived from the "Law of Initial Values". This explanation at best, is not relevant to the differential reactivity, but may have been of some conceptual use. Since the baseline differences did not appear in the second sample, we cannot consider it a promising lead at this time. There may be some unknown physiological difference between the two groups, but it is difficult to conceive of one that would cause the specific differential GSR reactivity to the relevant card.

The finding of a confirmed substantial positive correlation between card detectibility or "relevant" GSR reactivity and years of education seemed less surprising than the ethnic findings. Given such a finding which is independent of the ethnic variable it was puzzling that no relation between the relevant GSR reactivity and measured intelligence was found in these samples. It should be stressed that the variable - years of education - is very heterogeneous in the samples analysed. Some of the subjects studied in schools similar to those in Western Europe, but others did so within religious training institutions which are quite different in content taught as well as teaching methods employed.

It is possible that the correlation is based more on the likelihood of formal survival in an educational institution than on intellectual performance. Aside from intelligence what would differentiate between individuals who tend to stay in school, and those who drop out? One possibility would be to consider motivational variables appearing in either or both of the child or parents. Related to this might be the tendency toward conformity. A third variable which seems of interest would be any factor influencing the relevant mechanism of attention. This third variable will probably be easiest to examine in an experimental manner.

IV. EXPERIMENTAL EVALUATION OF GSR AND BLOOD PRESSURE CHANGE INDICES DURING CRIMINAL INTERROGATION

In a recent review of the use of polygraphs as "lie detectors" by the U.S. government it was concluded that there is a striking deficiency in experimental data concerning the validity of the polygraph that was collected under conditions similar to those existing in "real life" police interrogation (Hearings, 1964). Analysis of the data of the first experiment in our laboratory had suggested that while some degree of stress had been created, the experimental examinations were probably less stressful than those encountered during criminal suspect interrogation (Kugelmass, 1963). It was considered advisable to attempt another study under "real life" stress to follow up the stress explanation of the discrepancy in the evaluation of the GSR index in detection.

The present study was designed as an attempt to replicate the study described in chapter II under real life conditions. In addition an analysis of the blood pressure channel would be possible. While this channel is very highly rated by some police practitioners (Inbau, 1948), very few laboratory studies of its validity could be located by Davis (1961).

METHOD

Subjects: Sixty-two criminal suspects actually being interrogated in connection with serious offences were used as subjects.

Apparatus: A standard three channel Stoelting polygraph model with attachments for breathing, blood pressure, and GSR used at the central laboratory of the Israel Police.

Procedure: A part of most polygraph interrogations at this Police laboratory includes a card test. This is a standard procedure used in many laboratories (Inbau 1948). Instead of this usual card test, a standard technique was used that had been developed for the previous experimental study. The suspects, however, did not know about this change of procedure nor did they know that part of their examination was to be used for scientific purposes. The examination took place in the usual soundproof interrogation room. The suspect sat facing a blank wall. Stoelting GSR electrodes were attached to the volar surfaces of the second and fourth fingers of the left hand. The pneumatic tube used to record respiration was placed on the suspect's chest, and the blood pressure cuff was wrapped around the upper part of the right arm.

Following the attachment arrangements and the comfortable seating of the suspect, the experimental procedure was introduced. Each suspect was tested under two variations of the procedure, thus serving as his own control in a random balanced design to control for order effects. During the GSR and Cuff condition the Stoelting sphygmomanometer was inflated to a pressure of 90 mm. Mercury. This pressure was maintained for about ninety seconds during the experimental interrogation. The blood pressure cuff was not inflated during the GSR condition During both of these conditions the suspect was required to choose one of a

pack of six cards, to record the number of this card, and to answer "no" to all of the subsequent questions, "did you choose card number ..?" The number sequences were randomized while each umber appeared twice during the ninety seconds of questioning of each condition. In both cases the first number asked served as a buffer against initial startle and was not included in the analysis.

RESULTS

GSR channel - The two GSR responses (maximal change in mm. from baseline at time of presentation of the number) to each card was averaged. The card yielding the highest average mm. value was considered the "selected" card. Actual success in detection could be evaluated by comparing this card number with the one actually chosen by the subject and recorded by the subject during the experiment. The number of "hits" and "misses" in each condition is presented in Table 1.

Table 1

The number of cards correctly and incorrectly detected in the GSR and Cuff condition, and in GSR condition.

condition	results of detection	
	correct	incorrect
GSR and Cuff	32	30
GSR	35	27

The data was analysed against an assumed binomial model. (62,1/6) The number of "hits" or correct detections in the GSR and Cuff condition differed significantly from what might be expected by chance alone at the .001 level. The number of "hits" in the GSR condition was also significantly greater than chance ($\alpha < .001$). A chi square test for dependent proportions showed that the effeciency of detection of the GSR in the GSR condition is not significantly higher than the efficiency in the GSR and Cuff condition ($\alpha > .05$).

Blood pressure channel : In order to evaluate the efficiency of this channel the "notches"of this curve were connected, and deflections were measured from the baseline at the time of presentation of the card. As before the card yielding the highest mean deflection in mm. from the baseline was considered to be the "selected" card and was checked against the number recorded by the suspect. With this method employed 28 "hits" and 34 "misses" were obtained. Assuming the same binomial distribution as before the efficiency of the blood pressure channel appears to be better than chance at the .001 level. A chi square analysis for dependent proportions indicates that the efficiency of the GSR in the GSR condition is not significantly greater than the efficiency of the blood pressure channel during the GSR and Cuff condition ($\alpha < .05$).

DISCUSSION

The results of the present experiment may be taken as additional support for the efficiency of the GSR channel during stress. The ratio

obtained during this high level of realistic stress in 3.3, a bit higher than our own previous results (Kugelmass and Lieblich, 1966), and about equal to that obtained in the most detectable group studied by Gustafson and Orne (1963). It seems reasonable to conclude that the GSR channel does not lose its efficiency over the range of relevant stress. In addition to its practical implications for actual lie detection this would appear to be of theoretical interest in connection with the theoretical analysis offered in Woodworth and Schlosberg, (1956).

The results of the present experiment suggest a rather minimal interference effect of the blood pressure measurement procedure on the GSR channel. Further work will be necessary to analyse the reason for the difference between this weak effect, and the serious interference found in the study mentioned in chapter II. It may be suggested that parametric studies of this effect consider level of stress, cuff pressure, and time of cuff application.

An important new finding is the successful detection obtained through the use of the blood pressure channel. Since the pulse rate changes have been once more found to be of no significant use in the detection, other aspects of the blood pressure index rate further scrutiny. Since practically no correlation was found between GSR detectibility and blood pressure detectibility it may be possible to develop a combined decision rule more efficient than either of the two indices. Further analyses of this data will be made.

V. THE ROLE OF "LYING" IN PSYCHOPHYSIOLOGICAL DETECTION

Davis (1961) concluded recently that "the effectiveness of lie detection procedures is limited by a lack of knowledge of what psychological principles are involved in successful lie detection". It would appear that in order for detection to be possible the physiological changes must be generally larger during lying than when the subject is telling the truth. As a first step toward systematic analysis of this problem Davis describes three possible theoretical approaches which would account for the production of circumstances desirable for detection of deception: Conditioned response theory, Conflict theory, and Threat of punishment theory. After considering the reported material available he concluded that at present no decision is possible as to which, if any, of the three theories is correct, and that all may be operating to some degree. Actually one may ask whether the act of lying per se is the basis for the reported success in experimental studies of deception.

Most of the experimental lie detection data is based on a paradigm in which a subject gives "no" responses to a series of questions with only one of the nos being a lie. In a very recent study Gustafson and Orne, (1965), used two additional experimental situations: a silent one in which no verbal response was given to the questions, and another in which the subjects were required to answer the questions with associations. The authors interpreted their results as indicating that it is the act of committing a verbal lie, rather than merely responding

which leads to successful detection. While these results are suggestive, it is possible to question whether further control groups are not necessary in order for them to be conclusive. The association control design introduced non-standardized responses. Gustafson and Orne's careful investigation indicates that the subjects in the association group "paid little attention to the numbers presented".

The present study proposes to use a more parallel variation of the standard paradigm in which the subject would be required to say "yes" to every question. Both procedures involve giving the same single verbal response to every one of a series of parallel questions. In the NO condition he "lied" about the actual card chosen and told the "truth" about the other five cards. In the YES condition, in contrast, he told the "truth" about the chosen card and "lied" about the others. A very similar design was used previously by Ellson, Burke, Davis and Saltzman (1952) in a pilot study attempting to detect the month of birth of eight subjects. Possibly owing to the small number of subjects tested no conclusive results were obtained with little detection efficiency observed in the GSR channel under both conditions.

METHOD

Every subject was tested under the two experimental variations, thus serving as his own control in a random balanced design to control

for order effects. The sample consisted of seventeen first year university students, and ten army officers attending a course. The subjects were not informed as to the nature of the experiment beforehand. All of the testing was carried out in an air conditioned labor tory maintained at 21°C. with the previously described recording apparatus.

Both of the experimental variations required that the subject choose a card from a pile placed before him on the table (2,3,5,8,9 &10 of diamonds). He was asked to record the card chosen on a supplied form such that the experimenter was not aware of its identity during the interrogation which followed. In one of the experimental variations, which is similar to the design ordinarily used in this type of research, he was asked to reply "NO" to the subsequent questions "did you choose card number ...?" In the other experimental variation he was asked to reply "YES" to <u>all</u> of these same questions. The card number sequence employed in both variations were arranged so that each number appeared twice during the questioning. The sequences were taped and transmitted through an intercom using the number "one" as a buffer item against initial startle at the beginning of each series. Three minutes of basal skin resistance during a rest period was recorded prior to the first of the two conditions, and ohm units transformed into μmhos.

RESULTS

Analysis of the data obtained during each of the two conditions was carried out by determining the card number yielding the highest mean conductance change, and comparing this result with the number previously recorded by the subject himself. The number of "hits" and "misses" in each condition is presented in table 1.

Table 1

THE NUMBER OF CRITICAL CARDS CORRECTLY AND INCORRECTLY DETECTED IN THE "NO" CONDITION, AND THE "YES" CONDITION

Condition	Results of detection	
	correct	incorrect
No	16	11
Yes	19	8

Using a Poisson approximation to an assumed binomial model (27, 1/6), it was found that the number of correct detections in both conditions was significantly different from chance ($\alpha < .001$). Using a test for the significance of the difference of dependent proportions, it was found that the difference in detection efficiency between the two conditions was not significant at $\alpha = .05$.

DISCUSSION

The results would seem to indicate that the detection of the chosen card does not necessarily depend on the act of lying per se. This would suggest that other mechanisms may be responsible for the successful detection obtained in similar experiments in the past, and may be operating in the field work called "lie detection".

In view of the results let us consider the theoretical formulations of Davis. The first is the Conditioned response theory according to which the critical stimuli play the role of conditioned stimuli and evoke some "emotional" response with which they have been associated in the past. This theory does not really relate to the act of "lying" as such, although Davis specifically mentions it in this context, pointing to its inadequacy (p. 162, 1961).

The theory of Conflict is stated more directly in connection with lying behavior. The larger reaction during conflict is due to an interaction between a tendency toward denial and the "long habit which would dispose the person to answer a critical question straightforwardly". In the light of our results we would suggest that the specific conflict involving a lying reaction may be a sufficient but not a necessary condition for psychophysiological detection.

The third theory, or Threat of punishment theory, was also formulated in terms of a lying reaction although this need not have necessarily been

done. One possible interpretation of the punishment principle, which would be similar in some ways to a version of the Conditioned response theory, would have the fear of punishment based on the previous history of association between negative reinforcement and the act of lying as such. Another interpretation of Punishment theory, which is stressed by Davis (1961), is that it involves the fear of failure in a game-like situation, which is independent of the particular response evoked. Gustafson & Orne (1963) recently were able to detect subjects motivated to try and "beat the machine" but it did not exceed chance level with subjects who were not encouraged to do so. In the light of this study and our results, we would suggest that the first interpretation of Punishment theory is inadequate as a sole explanation of experimental detection of deception, and that further consideration be given to the second interpretation and its variants.

It follows from the analysis above that the theories presented by Davis (1961) require better explication if they are to be successfully tested. In this connection it would appear that the broader usages of "conditioning" and "punishment" should be avoided unless specific means of testing hypotheses using them are available. In addition to this need for more explicit specification of "lie" detection theory, further work is necessary toward understanding the mechanisms involved in momentary physiological reactions to stimuli.

VI. THE EFFECT OF VARIATION IN THE MODE OF STIMULUS PRESENTATION ON DIFFERENTIAL GSR REACTIVITY

The experiments to be reported in this chapter grew out of an attempt to conceptualize the lie detection experimental paradigm in terms of models suggested in the literature on information theory which relate to the mechanism of attention. MacKay (1961) had undertaken such an analysis of question and command forms of stimulus questions which seemed worth exploring within our experimental context.

EXPERIMENT 1

Subjects: Fifteen first year psychology students having little knowledge of lie detection procedure.

Recording apparatus : As described in chapter II.

Procedure: Every subject was tested under two experimental variations, thus serving as his own control in a random balanced design to control for order effects. Both of the experimental variations required that the subject choose a card from a pile of six placed before him on the table. He was asked to record the card chosen on a supplied form such that the experimenter was not aware of its identity during the interrogation that followed. In the Question condition, the subject was asked to answer "no" to the subsequent questions "did you choose card number ...?" The questioning inflection was emphasised in this condition. In the Command Condition, the subject was required to answer "no" to the same questions which were posed in a commanding voice. In Hebrew, it was possible to arrange for the wording in the two conditions to be identical. The two experimental variations were recorded on tape and transmitted to

the subject through a loud speaker placed on his table. The card number sequences employed in both variations were arranged so that each number appeared twice during the questioning.

RESULTS

The usual analysis in terms of detection hits and misses was applied. Ten hits were scored in both of the conditions such that with the assumption of a binomial model (15, 1/6) the results were significantly better than chance ($\alpha < .01$).

Given the similar detection rates it was decided to analyse further aspects of the data. It was found that:

a) The mean GSR response to the "hot" card in the Question condition was significantly higher than in the Command condition ($\alpha < .05$)

b) The mean GSR response to the "cold" cards in the Question condition was also higher than in the Command condition, but not statistically significantly so.

c) The GSR response to the buffer item was also significantly higher in the Question condition than in the Command condition ($\alpha < .05$)

DISCUSSION

The results suggest the possibility of some influence of the form of the stimulus presentation. It is of particular interest that the response differences appeared to be significant in connection with the

relevent or "hot" card, and the buffer item, but questionable in connection with the "cold" cards. Since the size of the former responses is generally greater than the latter, systematic differences due to this independent variable may only become apparent at a minimal level of response size.

Further consideration of the results suggested that it was possible that the experimental effect derived from a voice tone frequency change gradient occurring in the Question condition. It was thus possible that this change gradient rather than the specific grammatical form was the important variable.

A second experiment was arranged which would include the two forms of stimulus presentation within the visual modality. This would eliminate any physical change gradient, and permit evaluation of the structural variable.

EXPERIMENT 2 and 3

Subjects: A second sample of 15 first year students in the department of psychology participated in experiment 2.

Procedure: The same as in experiment 1, except that the stimuli were presented by a standard slide projector onto the wall facing the subject. The experimental room was illuminated as in experiment 1. The area of the image produced by the slide projector was 80 cm. x 50 cm. The subject sat at a distance of about 200 cm. from the blank whitewashed wall on

which the stimuli were presented. The stimuli in the Visual Question condition and in the Visual Command condition were identical in content to those presented in experiment 1, except that in the former a question mark was printed at the end of the stimulus text, while in the latter an exclamation mark was printed at the end of each stimulus. As stated in the procedure section of experiment 1 it was possible for the stimuli, presented in Hebrew to be formally identical, except for the differences described.

RESULTS

In both the Visual Question and Visual Command conditions the number of "hits" was five, and the number of "misses", ten. This number of detections cannot be considered as significantly different from what might be expected by chance alone. In addition, further analysis indicated that while the GSR response to the buffer item was significantly greater during the Visual Question condition, there was no significant difference regarding both the "hot" relevant card. and the cold cards.

The negative results of this experiment seemed of particular interest to us. because we had only seen such poor detection in the blood pressure interference effect previously described. We had never seen such a low rate in a long series of experiments on college students. It appeared desirable to try out the experiment on another type of sample. A third experiment was therefore carried out on a sample of

VII. IDENTIFICATION OF VARIABLES RELATED TO THE EFFICIENCY OF THE DETECTION OF INFORMATION WITHIN THE ORGANISM, USING A PHYSIOLOGICAL INDEX

(An abstract of a Ph.D. thesis submitted by Israel Lieblich to the Senate of the Hebrew University of Jerusalem, November, 1966)

The general aim of the reported study was to identify variables which might be related to the efficiency of the GSR channel for information detection. A review of the literature on lie detection, which may be regarded as a special case in the broader field of detection of information stored within the organism, indicated that no clear, testable theory existed to date behind the known facts. This difficulty stems from the more general lack of theoretical formulations in the broader field of what has been called "Short term physiological activation".

Work by Kugelmass, Lieblich and Bergman (chapter V), who showed that lying per se is not a necessary condition for the detection of information using physiological changes, and by Gustafson and Orne (1963), who found that the subjects' motivation may influence the efficiency of the detection of cards using the GSR, tended to reinforce the above mentioned claim that no satisfactory theory existed to date to explain known facts and predict new ones.

A review of the relevant literature pointed to the possibility

that in information detection based on the use of physiological changes one must consider the factors which influence "short term attention". The study presented is an attempt to test whether variables, known from the literature to be related to the arousal of "short term attention" may in properly ordered and planned combinations be reflected in physiological changes in the form of short term differential GSR responsivity. It appeared necessary to evaluate these factors as a first step toward building a general theory of differential short term physiological reactivity which would serve as the basis for the detection of information through physiological channels.

If it should be found that the same variables that influence short term attention produce systematic differential responsivity, it will be necessary to consider the findings so as to build a proper system of information detection. Given that variables influencing attention may bring about systematic changes in physiological reactivity, it would be important to allow for the influence of such variables as possible sources of interference. The experimenter observing physiological changes recorded from a subject cannot point to the exact source in the external or internal environment which produced a particular change. He may try to build a system which views an observed physiological change as reflecting the coincidence of his externally controlled stimulus with a "symbol" stored within the organism. Even then, the change may be due to some idiosyncratic "novelty" of this stimulus for the subject at this particular time which

is known to arouse short term attention but may be detrimental to information detection. These considerations suggested the use of the term "signal" for the item the experimenter may be interested in during a particular time interval, and "noise" for all other changes which may confuse the experimenter and produce errors of different types.

One of the most important components in the evaluation of signals inferred from the GSR and other physiological changes are the characteristics of the alternatives which produce additional changes which may functi as noise in the sense that they produce errors of various types. Not like the verbal channel which is essentially discrete in nature it is rare to find periods of "silence" in the GSR channel, which may mark the fact that nothing is transmitted. In fact every continuous physiological chann controlled in some way by the arousal system will show continuous fluctuation.

Every signal inferred from physiological changes is embedded in these fluctuations. One way to fight fluctuations is by reapplying the signal many times. This way of evaluating signals from physiological channels controlled by the arousal system may not be efficient because of adaption effects which may act differentially on the response to the signal. This hypothesis deserves an intensive parametric study which is not available as yet. There exist, of course, channels such as the EEG, in which precisely this method of combating noise is employed to extract, for instance, evoked potentials. Another method of identifying physiological

changes carrying a signal is by controlled production of possible noise samples, while comparing them with changes to known signals. A systematic comparison may produce attributes which distinguish between noise samples and signals.

The general problem with which this study was concerned was the identification and manipulation of variables which might produce in a controlled fashion, a contrast between what was defined in a particular time interval as a signal and what was defined at the same interval as unwanted noise. Thus an ordered manipulation of variables which might reflect wanted information and unwanted noise was carried out, the hypothesis being that the ordered contrast produced would be reflected in the physiological channel. It was clear that a successful control of this contrast might be important for the general understanding of "short term physiological activation".

The presentation of the synthesis process of the signal and noise sequences applied at the subject employs the concept of facets suggested and developed by Guttman (e.g. 1959).

Three clear facets arousing short term attention were identified in the literature: 1) Frequency of contact of the organism with a particular stimulus, within a given time interval.

2) Relevance of the stimulus for the organism which may be independent of frequency.

3) The use of the verbal channel in a standardized fashion as a response to the presentation of stimuli.

The presentation of the elements in the facets was in the direction of enhancing the contrast between what was defined as signal and what was called noise.

a) Facets of the signal

A = Frequency of usage of information within the organism.

a_1 = high frequency

a_2 = low frequency $\qquad a_1 > a_2$

B = Relevance of information stored within the organism.

b_1 = high relevance

b_2 = low relevance $\qquad b_1 > b_2$

b) Facets of the alternatives, or noise

C = Frequency of usage of alternatives within the organism.

c_1 = high frequency

c_2 = low frequency $\qquad c_1 > c_2$

D = Relevance of alternatives to the organism.

d_1 = low relevance

d_2 = high relevance $\qquad d_1 > d_2$

E = Use of verbal channel as additional response.

e_1 = verbal channel used

e_2 = verbal channel not used $\qquad e_1 > e_2$

From the Cartesian multiplication of the above mentioned 5 facets, 32 different profiles were possible, defining different combinations of signal and noise. It was possible to define groups of six profiles, each of which is completely ordered in the sense that while moving from one profile to the next only one index changes in a given direction with no reversal allowed. The following group of six profiles may serve as an example of a completely ordered group.

$a_1\ b_1\ c_1\ d_1\ e_1$

$a_1\ b_2\ c_1\ d_1\ e_1$

$a_1\ b_2\ c_1\ d_1\ e_2$

$a_1\ b_2\ c_1\ d_2\ e_2$

$a_2\ b_2\ c_1\ d_2\ e_2$

$a_2\ b_2\ c_2\ d_2\ e_2$

The central hypothesis of the reported study was that the systematic and ordered change of the attributes of the signal and the alternatives which produce hypothesized contrast changes between the signal and the alternatives will produce a gradient of contrast between the physiological changes observed when the signal and the alternatives were applied. This contrast in changes in the GSR amplitude was defined as signal to noise ratio (S/N). More explicity, it was hypothesized that the highest S/N ratio in the GSR will be observed when profile $a_1b_1c_1d_1e_1$ will be applied,

showing a reduction while moving through the next ordered profile, up to profile $a_2b_2c_2d_2e_2$ where the lowest S/N ratio will be observed at the physiological channel.

It should be noticed, that the system described above is limited in the kind of questions it may provide answers to. It will generally have no specific predictions for the relative size of the S/N index, when "parallel" profiles are presented to the subjects. For instance, no general predictions are provided by the system for the relative S/N measures produced by the application of profile $a_1b_2c_1d_1e_1$ as compared to the S/N observed when profile $a_2b_1c_1d_1e_1$ is presented to the subjects. The general predictive direction of the above presented system is within ordered steps of profiles. The predictions for the relation of parallel profiles using the S/N measure, need some notion for the relative weights of the described facets in producing signals and noise. To date, no a priori basis for differential weighing of the facets exists. When all possible profiles are tested, information for the behavior of the S/N index in parallel profiles, may be supplied. Using this information, hypotheses for the relative weights of the described facets in producing signals and noise may be deduced.

There is additional advantage in this approach in that it defines the information sought and the alternatives in a common conceptual framework, generating in this way many combinations which would test

the adequacy of the selected variables in controlling differential physiological responsivity. In general, it was very rare to find in studies dealing with attention arousal a clear common definition for all the alternates presented before the subject.

It is obvious that one of the important questions in the applied use of information detection is the generation of what is called "control" questions, which are essentially high noise samples, in comparison with which changes to possible signals are evaluated. Until sought signals and the alternatives are defined in the same framework, problems of interpretation of the observed physiological changes will continue to appear.

In addition to the described 3 facets, the reported study was interested in the age variable which is known to be related to short term attention. It seemed important to obtain impressions as to the feasibility of information detection in very young children using the GSR in as much as previous work (Kugelmass & Lieblich 1966) had indicated that there may exist groups of subjects differing in their GSR reactivity to relevant stimulation. Subjects of Eastern Mediterranean origin tended to show more GSR non-reactivity than subjects of European origin. It was of interest to see whether relevant non-reactivity may be a trait characteristic of very young children who allegedly are less able to concentrate. In addition, some biographical data concerning the parents of the subjects, such as years of education, ethnic origin etc., was gathered.

A special study was conducted so as to correlate GSR channel behavior of mothers and their children in order to gain more understanding of possible variables responsible for physiological functioning style. Vandenberg (1964) has shown that among twins there exists no genetic component in GSR reactivity. In the light of this finding Mother-Child correlations on GSR reactivity measures could give some indication of maternal effects on the variance of this channel.

26 children between the ages of 3 and 4 years, and 54 university students in their twenties, all born in Israel, participated in the reported study. Every subject was tested individually in six following conditions :

1) $a_1\ b_1\ c_1\ d_1\ e_1$

2) $a_1\ b_1\ c_1\ d_2\ e_1$

3) $a_2\ b_1\ c_1\ d_2\ e_1$

4) $a_2\ b_2\ c_1\ d_2\ e_1$

5) $a_2\ b_2\ c_1\ d_2\ e_2$

6) $a_2\ b_2\ c_2\ d_2\ e_2$

The experimental mapping of these profiles was as follows :

Condition 1 : Signal : Subject's name. Alternatives: 5 common names, known not to be related to the subject. Subject answers "no" verbally to all questions.

Condition 2 ; Signal : Subject' name. Alternatives: 5 names from the immediate family circle of the subject (father, brother etc.) Subject answers "no" verbally to all questions.

Condition 3: Signal : A new name given to the subject. Alternatives: As in condition 2. Subject answers "no" verbally to all questions.

Condition 4 : Signal : A very rare name not used as a first name for Israeli born. Alternatives : As in condition 2. Subject answers "no" verbally to all questions.

Condition 5 : As in condition 4. Subject is instructed not to answer any questions.

Condition 6 : Signal : As in condition 4. Alternatives : New names are given to the same members of the subject's family as used in condition 2. Subject does not answer any questions.

The order of presentation of the above mentioned was rotated, and in all conditions the question "Is your name ..." was employed. The procedure for 3-4 year olds group was identical to the one employed with adult group. Information on the subjects was gathered through home visits, carried out by an assistant who did not perform the interrogation. The experimenter who interrogated the subjects did not know their real names.

The results of the S/N gradient supported the hypothesis both in the children's sample, in which a Kendall rank order correlation of 0.70 was observed between the hypothesized order of the experimental conditions and their empirical order according to the contrast (S/N), and in the adults' sample in which a Kendall rank order correlation of 1.00 was obtained between the hypothesized order and the observed order of the conditions according to the mean S/N in each condition. S/N was defined as the GSR change in baseline to the signal, divided by the mean change in baseline to the alternatives.

Detection rates in the adult sample were highly significant in conditions 1 - 3 as defined above, and non-significant when the rare non-relevant name appeared (conditions 4 - 6). In the 3 - 4 year olds group detection of real names was possible only when employing a more severe restriction on minimal S/N value. This restriction created a detectable group which comprised a 1/3 of the original group.

Significant differences in the heights of the S/N gradients of the adults and of the children were observed in conditions 1 - 3, the adults showing a higher mean S/N ratio. It was found that this difference stems from the fact that the children showed more "noise" whilst the changes to the "signal" were practically identical to the ones observed in the adults. Thus it was concluded that relevant GSR non reactivity observed in previous studies in certain ethnic groups did not resemble GSR reactivity styles of very young children.

It was found that some indices of GSR reactivity, such as the orienting response and S/N ratio were correlated with biographical data of the parents : ethnic origin, years of education and socio-economic status.

The mothers of 13 children volunteered for a study in which a conventional card test was used. Some very high correlations between GSR reactivity measures observed in the mothers' records and GSR reactivity measures read from their children were observed.

It was concluded that the ordered combination of facets known from the literature to arouse term attention may be efficient in the controlled manipulation of differential physiological responsivity. This manipulation was successful both in very young children and in adults, the groups showing the same pattern but differing in the general level. Children show more reactivity to the alternatives than adults, but have the same mean signal. This finding was interpreted as showing a difference between young children and adults in their dichotomization ability of stimuli presented into a relevant and a rejected category.

Information detection using the GSR, was found to be possible in 3 - 4 year olds by employing more severe constraints on the minimal S/N ratio. In about 1/3 of the sample these constraints were observed and name detection rate was significant.

False signals arising from the application of rare names did not seem to cause spurious detection rates when evaluated against high noise generating alternatives. This may point to the fact that in a possible competition between novelty and relevance, the latter will activate more strongly the arousal system.

VIII RATIONALE FOR THE CONSTRUCTION OF THE WORRYING SCALE (WS)

The emphasis of the research upon individual differences in reactions to stress made it necessary to utilize some standard personality inventory directly related to anxiety. A review of the literature concerning the existing anxiety scales raised questions about their reliability and validity. It appeared that one common feature to all non-projective scales which may be responsible for this unsatisfactory state of affairs is the "transparent" nature of many of the questionnaire items. Even naive subjects can very easily guess which types of responses are categorized as "high anxiety", and which are "low anxiety" responses. This general visibility makes great demands upon the honesty of the person being tested. Since individuals vary in the degree to which they are disinterested in the impression they establish, the "social desirability" (SD) bias becomes of major importance. (Edwards, 1953, 1957). An additional drawback of most of such tests relates to the overall motivation of the testee, which cannot be assumed to be sufficient as in tests of abilities, especially if given in a research context. Taking the above considerations into account we decided to attempt the construction of a new type of test which might overcome these two problems of (SD) and motivation to some degree.

The search for a new test was not only stimulated by methodological considerations. Most of the items used in "anxiety scales" are anchored to the concept of anxiety in its extreme pathological context, as indeed

are many of the attempts of validation. It is possible that usage of such tools for the subtle discrimination between individuals within what is considered to be a normal population is unwarranted. This may be especially so if the object of the study is to analyse differential reactions to external stress rather than personality based crises. The specific test to be constructed, therefore, would deal with the everyday notion of worrying rather than what may be thought of as "clinical anxiety". It will be referred to as the "worrying scale" (WS) throughout this report.

The "social intelligence technique".

It was thought possible to solve the above mentioned methodological problems by a new technique which is based upon the following arrangements: The test is called a "Test of social intelligence" and the testee is told that this special aspect of his intelligence may be estimated from his performance. It is explained that there is only one correct answer to each item, and that at the end of the test a social intelligence score can be computed. The general feature of each item is a description of behavior which the testee must evaluate according to his best knowledge of the norms. The items, however, deal with behaviors of an extremely private nature, for which no clear norms exist. This makes it necessary to a large degree for the testee to base his guesses on his particular personal experience, and thus describe himself without suspecting the nature of the test. The social intelligence technique

attempts, therefore, to eliminate the (SD) bias, and at the same time to ensure maximal motivation by transforming a personality inventory into the competitive framework of a test of ability. The technique will be discussed in detail with the description of its various parts.

Components of worrying

Four different components of worrying were formulated and comprise the four parts of our scale. A brief description follows :

1) Intensity. This component deals with the degree to which the testee is concerned with problems which have little realistic basis, and tends to exaggerate their importance. The items include situations of social contact, social embarrassment, and worries related to ones' physical well-being. This component is tested in **Part A.**

2) Pessimistic quality. This component deals with the degree to which there is a tendency on the part of the testee to interpret the future as doubtful in a pessimistic way. This is tested in **Part B.**

3) Rigidity. Since one of the qualities of worrying appears as the inability of the individual to deliberately stop thinking about his problems, a specific attempt was made to test this component in Part C.

4) Personal history. Worrying, and especially non-pathological worrying may be partially determined by the particular history of traumatic events, unpleasant experiences and personal failures. A short biographical record of such events was therefore included in the test, and appears in Part D.

Description of items and the scoring system.

Part A. Part A consists of fifteen items each of which describes a person having certain apprehensions. Ss have to decide whether the particular response described shows natural apprehension (N) or exaggerated apprehension (E). The majority of the situations and behaviors with which these items deal are taken from what may be termed everyday experiences. They are, however, of a most private nature, which makes it practically impossible to "know" the right answer without projecting one's own experiences on to the behavior of people in general. The requirement of judging whether the apprehensions are "natural", i.e. frequent, normal, or "exaggerated", i.e. outstanding, pathological, makes it easier for undesirable responses to occur since if S behaves like the person in the item and hence regards it as a frquent natural response, he will disclose his apprehensions by calling them "natural". Each (N) response was regarded as indicative of worrying. On this part, therefore, the scale varies from 0 to 15.

On the basis of the first sample tested with (WS) the fifteen items of Part A were subjected to a scalogram analysis. (Guttman, 1941; 1944). Three Guttman scales were found, and their description appears in Table 1.

Table 1

Description of the three Guttman Scales of Part A

Items	Name of Scale	Coeff. of Reproducability
1,2,3,8	Social 1 (S_1)	92%
5,6,10,11,13, 15	Social 2 (S_2)	90.4%
4,7,9,12,14	Physical (P)	93%

S_1 may best be described as a dimension of worrying based on social inhibitions. The items deal with social encounters in which the hypothetical person knows what he wants to do, but has difficulties in overcoming his shyness and establishing the necessary social contact.

S_2 may best be described as a dimension of worrying based on embarrassment in social situations. The hypothetical person is not sure of himself and cannot decide how to perform.

P may best be described as a dimension of worrying based on exaggerated concern over one's health and physical fitness.

On the basis of these analyses it was decided to give five different scores on part A: S_1, S_2, P, $S_1 + S_2$ which reflects total social worrying, and T which is the total N score based on all the

fifteen items.

Part B. Part B consists of three items each of which describes a person anticipating a future event with only very limited relevant information at his disposal. Ss are requested to attempt a description of the thoughts that would be typical for a person in the given situation. Once again, the Ss have the set of "correct response", and try to guess. The description is then categorized into various types of thoughts, according to Table 2.

Table 2

RESPONSE CATEGORIES TO PART B

Category	Description
Ag	Aggression directed towards the person who is being late. (eg. "He is always late","I will tell him my opinion", etc.)
Nt	Neutral attitude, lack of emotionality and involvement (eg. "The person will observe his watch", "He will think about the possible reasons", etc.)
Op	Optimism (eg. "He will come soon", "He must be on his way", etc.)
Ps	Pessimism (eg. "Something bad happened to him", "An accident", or"Illness", etc.)

Rj	Rejection of self by the person who is late (eg. "He has forgotten me" "He does not care", etc.)
Rs	Reassurance (eg. "Everything will end well" "No reason to worry yet"., etc.)

Since the categorization was partially subjective two judges were used, with interjudge reliability of 90%. The scores are thus the frequency of appearance in each category. The length of the description (number of sentences) was another score utilized from part B.

Part C. In this part the S is requested to perform a simple experiment related to his ability to deliberately stop thinking about something. Following this attempt he is questioned about his success. Two items of similar form are used, and the proactive inhibition from the first to the second is tested in addition to the success on each attempt as such. The scores are based on the specific responses to the questions :

a) To what degree did you succeed in the task?

b) During what proportion of the time were you successful in the task?

c) In what part of the experiment did you succeed?

d) Did the experiment make you feel uneasy?

In addition, after the two trials, the S was questioned about his ability to concentrate. Combining the responses to all the questions

about success a total score on part C was given (C-score). Responses to question d were analysed separately so as to obtain an uneasiness score.

Part D. A list of 21 items representing possible events was presented to the S who was asked to relate which of the events had happened to him during his life. Once again the instructions stated that the problem is to find out whether diversive experience facilitates or interferes with social intelligence, so that this part did not appear out of the context within the WS. The items were divided into those representing events over which a person has no control, (e.g. surgery, traffic accident, etc.) and events which depend on the subjective appraisal of the situation, (e.g. feeling of great loneliness, disappointment, etc.). Thus, in addition to the total score based on the number of events checked, two sub-scores referring to the above mentioned division may be calculated. They are referred to as D-dependent and D-independent scores.

Following the four parts of the (WS) the Ss were requested to write any comments they might have concerning the test. The purpose of this was to find which if any S's suspected the true nature of the test. As will be shown later, this part provided us with some very interesting insights into the way this test was perceived by the Ss. In order to facilitate the evaluation of subsequent analyses, all the scores used in the (WS) are summarised in Table 3.

Table 3

Scores of (WS) used throughout this study

Part	Scores	
A	S_1	Social inhibitions
	S_2	Social embarrassment
	S_1+S_2	Total Social worrying
	P	Physical worrying
	T	Total intensity component
B	Ag	Aggression
	Nt	Neutral attitude
	Op	Optimism
	Ps	Pessimism
	Rj	Rejection
	Rs	Reassurance
C	Uneasiness	
	Total C-score	
D	D-dependent	
	D-independent	
	D-total	

The various components of worrying which were analysed as a theoretical framework for the construction of the (WS) were now tested empirically. It was thought desirable to obtain some information about the internal structure of (WS) by submitting its parts to an intercorrelational analysis. In order to achieve this, the test was given to a sample of 83 first-year psychology students. Since this was actually the first occasion on which the (WS) was used, it was interesting to note that only 2 Ss out of this already quite sophisticated group had any suspicions concerning the true nature of the test. On the whole, there was an atmosphere of competitiveness based on the notion of "social intelligence", and lively debates developed between Ss who finished their task as to the "correct answer" to some of the questions. A few Ss stated explicitly in their comments that they had to rely on their own private experience, since the test was too difficult and not much is known about the behaviours which were presented as stimuli. (On subsequent tests with different populations this sort of remark became quite frequent). The test took about 30 minutes, with the first Ss handing in their questionnaires after 15 minutes.

The internal structure of (WS)

In order to test the interrelations between the three intensity scales the Pearson's coefficient of correlation was computed. The correlations are presented in Table 4.

Table 4

Correlations between the various intensity components

	S_1	S_2	S_1+S_2	P	T
S_1	X	.12	.55	-.20	.49
S_2	.12	X	.78	.10	.72
S_1+S_2	.55	.78	X	-.08	.78
P	-.20	.10	-.08	X	.52
T	.49	.72	.78	.52	X

Table 4 indicates that S_1 and S_2 appear to measure different components of social worrying. ($r = 0.12$). By the same argument it would suggest that the P scale is unrelated to the social scales, and is even slightly negatively related to the social inhibition scale ($r = -0.20$). The correlations between these subscales and the total indices (S_1+S_2, and T) are, of course, spuriously inflated by common elements.

All the 15 items of part A were intercorrelated with each other, and the correlations appear in Table 5.

A factor analysis was made in order to locate the first factor. The loadings appear in Table 5. Analysis of these loadings led to the conclusion that the first factor is one of intensity. The intensity relates to the degree of 'damage' to be expected if the event described in the item would materialize, i.e. the apprehensions would come true.

The intercorrelations between categories of Part B are given in Table 6.

Table 5 ; Intercorrelations between items of Part A

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	F_1
1		0.13	0.021	−0.12	−0.091	0.009	−0.12	0.096	−0.12	0.089	−0.134	−0.29	−0.005	−0.008	0.041	0.20
2	0.13		0.13	−0.19	0.043	0.029	0.22	−0.053	−0.066	0.21	−0.082	−0.049	−0.09	0.11	0.203	0.25
3	0.021	0.13		0.004	0.066	0.024	−0.006	0.11	−0.049	0.145	0.124	−0.31	0.15	0.13	0.23	0.36
4	−0.12	−0.19	0.004		−0.134	0.056	0.22	−0.061	0.047	−0.14	0.079	0.23	0.23	−0.070	0.012	0.08
5	−0.091	0.043	0.066	−0.134		0.21	0.036	−0.015	0.068	−0.007	0.022	−0.12	0.23	−0.019	0.053	0.14
6	0.009	0.029	0.024	0.056	0.21		0.18	−0.033	0.11	−0.024	−0.11	0.036	−0.03	0.036	−0.103	0.18
7	−0.12	0.22	−0.006	0.22	0.036	0.18		−0.14	0.17	0.006	0.064	0.044	0.23	0.016	0.083	0.47
8	0.036	−0.053	0.11	−0.061	−0.015	−0.033	−0.14		−0.101	−0.233	0.097	−0.12	0.009	0.204	−0.039	0.11
9	−0.12	−0.066	−0.049	0.047	0.068	0.11	0.17	−0.101		0.154	−0.11	0.073	0.015	0.43	0.02	0.30
10	0.089	0.21	0.145	−0.14	−0.007	−0.024	0.006	−0.233	0.154		−0.19	0.083	−0.22	0.22	0.19	0.13
11	−0.134	−0.082	0.124	0.079	0.022	−0.11	0.064	0.097	−0.11	−0.19		−0.19	0.16	0.059	0.089	0.05
12	−0.29	−0.049	−0.31	0.23	−0.12	0.036	0.044	−0.12	0.073	0.083	−0.19		−0.234	−0.124	−0.022	0.40
13	−0.005	−0.09	0.15	0.23	0.23	−0.03	0.23	0.009	0.015	−0.22	0.16	−0.234		0.21	0.033	0.32
14	−0.008	0.11	0.13	−0.070	−0.019	0.036	0.016	0.204	0.43	0.22	0.059	−0.124	0.21		0.018	0.56
15	0.041	0.203	0.23	0.012	0.053	−0.103	0.089	−0.039	0.02	0.19	0.089	−0.022	0.033	0.018		0.30

This hypothesis is substantiated by the relationship between Nt and the intensity component as measured in Part A by the Total score. This relationship can best be seen in the frequency distributions as presented in Table 7.

Table 7

Relationship between Nt (Part B) and T (Part A)

T	Nt	0	1+	Total
Low	(1-5)	1	9	10
Medium	(6-9)	16	43	59
High	(10-15)		14	14
Total		17	66	83

Table 7 indicates that category Nt is used only by Ss who fall in the medium range on the intensity component. This supports the notion that Nt is an attempt to keep a balanced, neutral, uncommitted, unemotional attitude throughout the test.

Another interesting finding concerns the correlation between category Rs (reassurance) and the intensity component. The correlation was found to be 0.30 ($p < .05$). This is in line with the notion that the particular scoring system of Part A where Ss exhibit their worries by reassuring themselves that they are natural is operating and influencing the Ss.

In order to find out whether the length of response to Part B relates to worrying, the X^2 test was used to test for the independence of this

measure of the intensity component. The X^2 was found to be 6,0 and hence the hypothesis of independence must be abandoned ($p < .02$). It appears that length of response is indicative of worrying.

No significant correlations were found between the scores of Part C and those of Parts A and B. The two items in Part C were, however, significantly correlated ($r = 0.59$), and therefore justify the computation of a total score for Part C.

Part D was found to be independent of the other components, and it was thus thought appropriate to include all the original parts of (WS) in any future attempts to validate this test. The fact that no high correlations were found suggests that no part of (WS) may be regarded as redundant.

External validation 1 : Correlations with manifest anxiety and SD

Sarason (1960) rightly stated that the Taylor Manifest Anxiety Scale (MAS) may be regarded as one of the major tools in research concerning individual differences in anxiety, or general level of activation. The relatively simple procedure and scoring, as well as availability of a substantial body of knowledge relating to this scale made it a natural choice for a cross-validation study. Since MAS is one of the tests higuly influenced by the Social Desirability (SD) variable (Edwards, 1957; Sarason, 1960), and since the possible elimination of this variable was one of the chief purposes in the construction of (WS), it was possible to study the relationships between all the three scales (MAS), (SD), and (WS) at the same time.

Forty students of first year psychology were the Ss of this study. (The WS was administered three months after the other two tests to 83 Ss who have been discussed in previous sections, but only 40 of those were given (SD) and (MAS) as well).

The correlation between (SD) as measured by the Edwards scale and (MAS) was found to be $r = -0.52$ which is in the predicted direction ($P < .01$). The basic premise that the (SD) variable accounts for a substantial part of the variance in (MAS) was thus supported.

The correlations between (MAS), (SD), and various scores of (WS) are presented in Table 8.

Table 8 : Intercorrelation between WS, MAS, & SD

WS		MAS	SD
A	S_1	0.08	0.03
	S_2	0.00	0.17
	S_1+S_2	0.18	0.14
	P	0.22	0.08
	T	0.20	0.11
B	Ag	0.08	0.08
	Nt	-0.15	0.14
	Op	-0.09	0.02
	Ps	0.04	0.02
	Rj	0.02	0.03
	Rs	- 0.11	0.06
	length	0.28	0.10
C	Unease	0.29	0.07
	Total-C	0.05	-0.14
D	dependent	0.17	-0.14
	ind.	-0.10	-0.18
	Total D	0.11	-0.17

Table 8 indicates that the correlations between (MAS) and (WS) are very low, and none of them reaches statistical significance. There is a trend towards a positive relationship with Part A (intensity component), length of response on part B, uneasiness on part C, and D-dependent score. One should raise the question, however, to what degree should high positive correlations be expected at all once it appears that (SD) is accounting for a great part of (MAS) responses? In other words, the question is, how strong can the "anxiety component" of (MAS) be?

Additional light can be thrown on this problem by analyzing the correlations between (SD) and (WS). Here, however, there is no indication that (SD) is negatively related to (WS), and, therefore, that the (WS) score reflects attempts of the Ss to appear in a desirable (non-pathological) light. On the contrary, although not statistically significant, there is a slight tendency toward a positive correlation between the two. Thus, the present data indicate, that if (WS) would be meaningfully related to some other indices of "anxiety" or "worrying", it would be cleared of the (SD) component. Closer analysis of the correlations with (SD) can throw some light on the different parts of the scale. As already mentioned, part A shows a slight positive relationship, whereas in part B only the category Nt has any relationship at all, and again in a positive direction. This would support the notion discussed earlier, that this category is indicative of an attempt to avoid the test situation in an uncommitting manner. Total score of part C and all the scores of part D are negatively related, and one may conclude that the true nature of the test is less

camouflaged on those sections. This finding may be expected since in parts C and D the Ss are giving information about themselves explicitly, whereas in parts A and B they are guessing the behavior of other people.

The partial correlation between the Total intensity component and (MAS) while holding the (SD) constant is $r = 0.60$ ($P < .01$) which may be due to their mutual "anxiety component". Actually, such a partialling out procedure might make most of the correlations positive and significant, due to the opposite effect of (SD) on the two scales.

To sum up : The pattern of (MAS) correlations is interesting, but cannot be used as validation. It appears that there is a high loading of social desirability (SD) operating which justified our hesitance in accepting it for our research purposes. More important was the success in eliminating (SD) as a factor in (WS). This will become more meaningful if it becomes possible to demonstrate the validity of (WS) by some other means.

External validation 2 : Reactions to experimental stress.

Since the major aim of the construction of (WS) was the analysis of individual differences in reaction to stress, it was natural to try and validate this scale on data close to this objective. Therefore, an experiment was designed to include the following: baseline physiological readings, reaction to threat, ability to function during stressful anticipation, reaction to a stressful event itself, ability to relax quickly, etc.. It appeared reasonable to assume that processes of

apprehension and worrying would be more easily demonstrated in a stress situation based on Ss anticipation of an unavoidable frightening event, than in stresses which like problem solving situations allow the Ss some control over the consequences and distract his mind. On this assumption, the design of the experiment was essentially an anticipation paradigm, with the actual stressor having only a secondary role.

METHOD

Subjects: Thirty-six volunteer psychology students, who were tested on (WS) two months earlier, were the Ss of this experiment. They were naive concerning the purpose of(WS), and, therefore, could not relate the taking of that test (embedded in a battery of other tests) two months earlier to the experiment.

Apparatus and Procedure. The experimenter (E), wearing a white coat, received S at the laboratory and requested him to sign a pledge of secrecy concerning the experiment. The S was then attached to The Sanborn Carrier Preamplifier (Model 150-1100) for recording of GSR and Heart-rate. Following three minutes of baseline recording the S was given the usual card detection task. The E returned to the room after the detection procedure and immediately adjusted the lighting and left the S in semi-darkness. The S was then given highly dramatic information stressing the unpleasant aspects of the experiment without specific reference to an electric shock. The E re-entered the room, placed a shock electrode on Ss right hand, and placed a watch on the table before the S where it could be easily seen.

The threats. Two threatening aspects were presented to the S. The first threat consisted of informing the Ss that they have to wait for 6 minutes before reviewing a strong shock. The second threat consisted of instructions connected with the request to be prepared to substract numbers by heart, as quickly as possible without making mistakes during the anticipation period. At this point the Ss were asked to look at the watch, and wait for the starting signal, as well as for the subtraction test. Following the signal Ss were given the number 5 and asked to continuously reduce it by 17, as quickly as possible. This went on for the first minute of anticipation, and was repeated (with the only difference being the starting number) at the third and fifth minute of anticipation.

Following the third substraction task Ss were reminded that there was only one minute left before the shock would be given. Five seconds after the shock was due it was actually given (using a 90V battery).

Relaxation. Two minutes after the presentation of the shock Ss were threatened with a second, stronger shock without any specific mention of time. Following the start signal, however, E entered the room, took off the shock electrode, and explained thatno more shocks would be given, and that he had only been threatened in order to study how well he would be able to relax. The S was then left alone and requested to observe the watch and relax. Twelve minutes were given for relaxation, and then a last substraction task was given which terminated the experiment.

RESULTS

Scores of the physiological data.

In order to facilitate meaningful comparisons with the physiological data, the following scores were computed for both the GSR (conductance) and the Heart-rate (beats per minute) channels :

Baseline (Based on the readings on the second minute of recording)

Fear of shock (Based on readings at $\frac{\text{minute 6 - Baseline}}{\text{Baseline}}$)

Fear of threat (based on readings during $\frac{\text{threat instructions - Baseline}}{\text{Baseline}}$)

Fear of Subtraction (Based on readings at minutes 1,3, and 5 - 2, 4, and 6)

Lability (Based on the highest-lowest readings)

Relaxation intensity ($\frac{\text{First minute of relaxation - lowest reading in relaxation}}{}$)

Relaxation speed (Number of minutes until lowest reading during relaxation)

In addition to these scores the absolute readings for every minute during the entire experiment were computed.

Intensity component

Table 9 presents the coefficient of correlations between the physiological scores and intensity scores for both Conductance and Heart-rate.

Table 9

Correlations between intensity component and pysiological scores.

Physiological Score	Heart-rate					Conductance				
	S_1	S_2	S_1+S_2	P	T	S_1	S_2	S_1+S_2	P	T
Baseline	0.07	0.29	0.25	0.04	0.19	-0.29	-0.15	-0.24	0.06	-0.15
Fear of shock	0.43	0.39	0.46	0.11	0.46	0.49	0.50	0.57	0.23	0.56
Fear of threat	0.16	0.05	0.11	0.06	0.11	0.49	0.51	0.55	0.11	0.48
Fear of substraction	-0.40	-0.36	-0.43	0.09	-0.29	-0.18	-0.21	-0.22	-0.13	-0.24
Lability	0.21	0.60	0.51	0.42	0.63	0.52	0.47	0.57	0.47	0.54
Relaxation intensity	-0.14	0.15	0.07	0.30	0.17	0.11	0.51	0.39	0.04	0.32
Relaxation speed	0.11	-0.36	-0.18	-0.17	-0.23	-0.14	0.35	0.15	0.22	0.22

Table 9 indicates that the intensity of fear reaction to the threat of shock is significantly positively related to the intensity component of (WS). This happens in both physiological channels. Interestingly, it is the social components of worrying which are highly correlated to fear, although the stress of shock may be viewed as a physical stress rather than a social one. The verbal instructions of threat are frightening in their own right and the degree of fear-reaction is positively related to the intensity component. This, however, appears to be the case in the conductance channel, only with no significant

correlations for the heart-rate channel. Fear of substraction is negatively related to the intensity component, significantly so in the heart-rate channel. Lability is significantly positively related to intensity component in both channels. Concerning relaxation there is no clear picture, but conductance scores appear to be positively related to both intensity and the speed of relaxation. On the whole, the correlations with the intensity component are high, and this component appears to account for a certain amount of variance in the individual reaction to stress. Of special importance are the clear-cut findings concerning the basic score of fear-reaction to shock, and one should keep in mind the basic inconsistencies between the physiological channels themselves in order to appreciate this finding. The comparison of the two stresses : i.e. shock and substraction, suggests that they may be of different quality, and fear of one does not necessarily mean the fear of the second. On the contrary, it is pssible that for some Ss the task of substraction actually served as a distractor from the anticipation of the shock.

Part B

Table 10 presents the coefficients of correlation between the physiological scores of heart-rate and the pessimism component.

Table 10

Correlations between part B of (WS) and heart-rate scores.

Heart-rate score	Ag	Nt	Op	Ps	Rj	Rs	Length
Baseline	0.17	0.14	0.10	0.06	-0.04	-0.04	0.20
Fear of shock	0.05	0.25	0.77	0.09	-0.54	-0.33	-0.06
Fear of threat	0.02	0.17	0.68	0.28	-0.39	-0.18	0.10
Fear of subtraction	-0.13	-0.01	0.10	-0.02	0.10	0.16	0.14
Lability	0.22	-0.42	-0.41	0.09	0.22	0.09	0.10
Relaxation intensity	-0.12	0.03	-0.26	0.03	-0.22	0.00	-0.34
Relaxation speed	-0.17	0.45	-0.11	-0.07	-0.52	-0.03	-0.22

The major finding in Table 10 is the number of highly significant positive correlations between fear of shock and fear of threat and optimism. This suggests the appearance of "defence" in a frightening situation. Such a denial hypothesis is further strengthened in view of the negative correlations between rejection and fear. Another interesting finding is the significant negative correlation between lability and neutral attitude. This again supports the notion of Nt being an attempt to avoid the emotional components of the situation. Ss neutral in the (WS) are more neutral in their physiological responsiveness to stress.

Table 11 presents the coefficients of correlation between the physiological scores of conductance and the pessimism component.

Table 11

Correlations between part B of (WS) and conductance scores.

Conductance score	Ag	Nt	Op	Ps	Rj	Rs	Length
Baseline	-0.02	-0.21	-0.13	0.11	0.52	0.06	0.18
Fear of shock	0.12	0.14	0.20	0.04	-0.40	0.10	0.09
Fear of threat	0.14	0.21	0.26	0.06	-0.33	0.31	0.19
Fear of subtraction	-0.21	0.07	-0.24	-0.09	0.46	0.23	0.36
Lability	-0.10	0.18	0.15	0.00	-0.25	-0.01	-0.09
Relaxation intensity	0.32	-0.29	-0.24	0.32	0.52	0.02	0.28
Relaxation speed	0.25	-0.43	-0.23	-0.07	0.44	-0.02	0.02

Table 11 indicates that rejection is negatively related to fear of shock and fear of threat in both heart rate and conductance indices. This, together with the tendency(not reaching statistical significance) of optimism to relate positively to these two scores of fear reaction is additional support of the "denial" hypothesis.

Both tables again point to the fact that the two stresses employed in this study do not influence the Ss in a parallel way. If any, the relationship between them appears to be negative.

Parts C and D

Table 12 presents the coefficients of correlation between C and D of (WS) and the physiological scores.

Table 12

Correlations between parts C and D of (WS) and the physiological score

Physiological score	Heart-rate					Conductance				
						C			D	
	Uneas.	Total	Dep.	Ind.	Tot.	Une.	Tot.	Dep.	Ind.	Tot.
Baseline	0.28	0.11	0.05	0.00	0.05	0.13	0.36	0.16	0.22	0.00
Fear of shock	-0.09	0.03	-0.11	0.07	-0.06	-0.20	-0.31	-0.03	0.12	0.02
Fear of threat	- 0.13	-0.36	-0.10	0.05	-0.04	-0.13	-0.25	-0.11	0.08	-0.05
Fear of sub-traction	-0.03	-0.50	-0.36	0.19	-0.24	0.11	0.21	0.09	-0.07	0.04
Lability	-0.06	-0.21	0.04	-0.17	-0.03	-0.12	-0.09	-0.08	-0.01	-0.06
Relaxation intensity	-0.03	0.09	-0.31	-0.41	-0.39	0.29	0.20	-0.38	-0.33	-0.40
Relaxation speed	-0.03	0.08	-0.13	-0.12	-0.14	0.21	0.12	0.04	-0.34	-0.09

Some interesting trends appear in Table 12. A systematic pattern appears to exist between relaxation (especially intensity) and Part D. It is apparent that the greater the number of unpleasant past events reported, the smaller the relaxation after stress. Part C (both indexes) seems to be negatively related to the physiological reactions of both channels. The baseline of Conductance, however, is positively related to C.

(WS) and performance under stress.

The particular design used in this study provides information regarding the ability of S to concentrate on the substraction of numbers during anticipation of shock. On the basis of the task used, the following scores could be obtained:

Number of responses given during one minute (Total R)

Number of correct responses (R+)

Number of mistakes (R-)

All of the responses obtained during the four substraction efforts of the experiment were scored. The sum total of these responses based on all four minutes was used as a total performance score.

Table 13 presents the correlations between (WS) scores and performance scores.

Table 13

Correlations between (WS)scores and performance scores

(WS) Score		Total R	R+	R-
Part A	S_1	-0.60	-0.54	-0.16
	S_2	-0.40	-0.42	0.13
	S_1+S_2	-0.57	-0.55	0.09
	P	0.03	-0.10	0.29
	T	-0.42	-0.44	0.14
Part B	Ag	0.11	0.15	-0.18
	Nt	-0.01	0.07	-0.23
	Op	- 0.26	- 0.29	0.13
	Ps	-0.08	-0.10	0.04

Table 13 (cont.)

(WS)	Score	Total R	R+	R-
Part B	Rj	-0.23	-0.19	-0.14
	Rs	0.08	0.02	-0.23
	Length	-0.23	-0.11	-0.42
Part C	Uneasiness	-0.07	0.10	-0.30
	Total - C	-0.30	-0.26	-0.13
Part D	D-dependent	-0.20	-0.16	-0.14
	D-independent	-0.15	-0.04	-0.19
	D-Total	-0.21	-0.17	0.14

Table 13 indicates that there is a significant negative relationship between performance under stress and the intensity component of (WS). Closer examination of the table suggests, however, that it is not the quality of performance as such that is reduced by worrying, but rather the quantity of performance. The negative correlations are highest with the Total number of responses given during the task. There are fewer positive responses, but not significantly more mistakes. Given that the probability of a correct response is greater than the probability of mistakes (as indeed the means in this study indicate), one may interpret the above findings as worrying having an inhibitive influence upon performance in general. Such an explanation would then fit all the data presented in Table 13. Once again, the social scales of intensity have higher correlations than the physical one. Interestingly, it is the

physical scale of part A that is the best predictor of mistakes. The correlations with parts B, C, and D are not significant, but the tendency for negative relationship is highly consistent. Once again, it is optimism that resembles the intensity component more than pessimism, which is in line with the denial argument already mentioned before.

To sum up : The data from this stress experiment have thrown additional light on the nature of (WS). The intensity component was found to be a good predictor of physiological reaction to threat and to the stress itself. It was found that responses of optimism in part B responses are related to higher fear reaction than other responses. Rejection responses are indicative of lower fear. Parts C and D were found to predict the degree of relaxation following stress. In addition, all the scores of (WS), but especially the intensity component, were predictive of performance under stress. The higher the worrying, the fewer the appropriate responses made.

External validation 3: Psychosomatic patients.

It was thought desirable to attempt the validation of (WS) in a third and completely different manner. Frequent worrying and inability to relax are regarded by many as basic elements in the etiology of some of the psychosomatic syndromes. On the basis of this assumption it appeared conceivable that patients suffering from psychosomatic illnesses would score higher on (WS) than patients whose diagnosis is entirely one of somatic ailment. The study to be reported should be regarded as a preliminary attempt in this direction.

Subjects.

Ss for this study were tested at three different places: The Hadassah Medical School clinic, one of the wards of the Hadassah Hospital, and Sanatorium Arza in the vicinity of Jerusalem. The selection of patients was based on their having sufficient knowledge of the Hebrew language. The patients were told that the (WS) is part of the testing procedure of the clinic and the ward. All patients attending these places at the time of testing were tested independently of their diagnosis. The diagnosis itself was obtained from the medical authorities at a later stage. All in all 98 Ss were tested.

Diagnosis

Examination of the available medical information led us to doubt the usefulness of an analysis based on the diagnostic decisions appearing in the files. An attempt was therefore made to utilize this material in a more systematic but preliminary way. Eight physicians agreed to evaluate the patient descriptions and classify them into three categories: a clinical picture never indicative of psychosomatic illness, sometimes indicative of psychosomatic illness, and always indicative of psychosmatic illness.

An evaluation of the physicians' efforts indicated that there was almost perfect agreement in regard to classification within the "mostly" category. It appeared to be of little use to include the "sometimes" category where agreement was not high. The main body of S's placed into the mostly category suffered from asthma, ulcers, and colitis ulcerosa.

A dichotomous analysis was undertaken in which the thirty three patients placed in the mostly group were compared with all of the rest of the patients (N = 65)

Given the diagnostic problems the results must be taken with much reservation. There was a significant tendency for the psychosomatic subjects to give more worrying responses on three items of Part A (items, 1, 9, 13). Other nonsignificant tendencies in the same direction appeared in other items of Part A. In Part B it was found that psychosomatic patients used category Ps and category Rj more often ($P\ x^2 < .05$). The pessimistic outlook and lack of self confidence might be psychological factors related to the development of psychosomatic complaints.

In addition, a superficial analysis suggests that there is a higher degree of reported worrying behavior in our total patient population (independent of diagnosis) than in the student population tested. Further effort will require new and better samples.

Individual Reactions to Stress and Detection of Information

Twenty two student volunteers had been given the WS, and had participated in both the stress validation experiment and the detection experiment (Chapter VI). It appeared useful to relate these two lines of work through a correlational analysis of their joint data.

A S/N score ($\frac{\text{mean GSR response to hot card}}{\text{mean GSR response to cold cards}}$) was computed for each subject. This score was correlated with all of the (WS) indices and the psychophysiological indices of the stress validation experiment.

Two interesting correlations emerged which appear to be worth following up. A Pearson correlation of +0.51 was obtained between the S/N score and part C of (WS). This suggests that a given stimulus pattern produces a higher signal to noise ratio when the subject feels that he cannot intentionally stop thinking about a specific stimulus. Detectibility was found to have a negative (-0.53) correlation with the fear of shock score in the heart rate channel. The parallel GSR score was not related in any way to detectibility. This suggests that the most frightened individuals may be poor subjects for detection.

APPENDIX

"SOCIAL INTELLIGENCE TEST"

Name _____

The purpose of this test is to find out to what extent people can put themselves in the place of other people and guess their reactions to all sorts of situations.

The correct answers to the various questions in this test are known from previous research studies so that everybody can be given a score of success in "social intelligence".

Concentrate on each question and try to do as well as possible. There is no time limit.

Part A

Before you is a list of unpleasant situations that every person may encounter. For every situation you have to judge whether the person's reaction as it is described shows natural apprehension (put circle around N), or exaggerated apprehension (put circle around E). Do not skip any questions; if you don't know the answer make a guess.

N E 1. A person is in a hurry to find an unknown address. He does not approach anybody, but deliberates about whom to ask.

N E 2. A person sitting in a bus is uncomfortably cold because of an open window. Nevertheless he lets quite a while go by before asking his neighbor to close it.

N E 3. A person would like to ask his boss for a raise, but constantly puts off doing so.

N E 4. A young man sometimes thinks about his old age.

N E 5. A person bought a ticket to a show, but came late to the performance. He does not dare to enter alone, and waits for other late comers.

N E 6. A person feels that he ought to console another person who is in mourning. He can not make up his mind, and in the end does not go.

N E 7. A person who feels some pains, and fears he has cancer before he has been examined.

N E 8. A person entering a bus discovers that he does not have enough money for the ticket. He does not ask anybody for a loan, but walks home instead.

N E 9. Somebody was offered an appetizing fruit, but refused it because he suspected that the fruit was not washed.

N E 10. A person entertaining a guest constantly fears that something will go wrong.

N E 11. A person is walking along the street and sees somebody whom it is unpleasant for him to meet. He quickly crosses the street.

N E 12. A sudden screech of brakes is heard. A person can not concentrate on anything, fearing that somebody got hurt.

N E 13. A few minutes before important guests were due to arrive the main course of the dinner was burned. The host was highly embarrased.

N E 14. A person pays the insurance company according to the number of items insured. He has life insurance, disease, accident, fire, theft, house and property insurance.

N E 15. A person comes to visit somebody, and after a short time begins to feel that he is disturbing and should leave.

Part B

In this part of the questionnaire you have to guess the thoughts of people in all sorts of situations. In order to make this difficult task easier for yourself, you are requested, after reading each question, to close your eyes for a certain time, and imagine to yourself the described situation. Answer the question after you have thought about the problem. Remember,not the speed but the quality of your answer counts.

1. A person waits for somebody he is very fond of to arrive, but he is late. Try to guess what he will probably think in this situation, and describe his thoughts.

   Close your eyes .....

2. A person received a notice from the Post Office that a telegram awaits him. Try to guess his thoughts on his way to the Post Office to collect the telegram.

   Close your eyes.....

3. Person A told person B that he has something important to tell him and invited him to come see him the next day,

   a. Did person B think about this message just before he fell asleep?

   b. Did person B forget it?

   c. Did the message evoke more hope or apprehension in person B?

   Close your eyes .....

_____

_____

_____

_____

_____

Part C

The place of ability to concentrate in relation to intelligence is doubtful. An original approach to a complex problem probably requires full concentration; on the other hand, it is also possible that the ability to jump from one issue to another is the key to originality.

It is not easy for people to deliberately stop thinking about a certain subject. The thought returns again and again. In this part of the questionnaire you will test yourself in this respect.

1. Close your eyes for about one minute, and try during that time <u>not to think</u> about a bus.

   Start now .....

   a. To what degree did you succeed?

      very much/much/ a little / almost not/ not at all

b. What proportion of the time did you succeed?

most / substantial / small/ very small

c. At what stage?

Beginning / middle / towards the end

d. Did this task make you feel uneasy?

very / substantially / a little / not at all

2. Try now again, this time <u>don't think</u> about clouds.

Close your eyes .....

a. To what degree did you succeed?

very much / much / a little / almost not / not at all

b. What proportion of the time did you succeed ?

most / substantial / small / very small

c. At what stage?

beginning / middle / towards the end

d. Did this task make you feel uneasy?

very / substantially / a little / not.

3. How do you evaluate your ability to concentrate generally ?

excellent / good / not bad / weak / very weak

Part D

There is an argument that people who have had a variety of different experiences have higher "social intelligence". On the other hand, some claim that past experiences interfere with "social intelligence". Please answer the following questions <u>honestly</u>, in order to help clarify this issue.

Here is a list of situations that one might encounter his life. If you did experience a situation, put a circle around its number.

1. Difficult illness
2. Surgery
3. Miraculous escape during danger (what danger?) _____
4. Death of a relative
5. Road accident
6. Present as a man was dying.
7. Difficult separation from a loved person.
8. Feelings of unusual physical fitness.
9. Danger (in the army, or any other occasion) what danger?_____
10. Economic loss
11. Successful execution of an important plan
13. Big disappointment
14. Shattering information
15. Subjugation (by a teacher, boss, parents, friends) who?_____
16. Win in a lottery.
17. Feeling of heavy guilt concerning a transgression.
18. Holding of great responsibility with apprehensions of failure.
19. Grave doubts and inability to decide.
20. A strong feeling of shame.
21. Hurt somebody seriously unintentionally or because you did not have a choice?

REFERENCES

1. Bernstein, A.S. Race and examiner as significant influences on basal skin impedance. J. Pers. Soc. Psychol. 1965, 1, 346 -349.

2. Davis, R.C. Physiological responses as a means of evaluating information. In A.D. B iderman and H. Zimmer (Eds.), The manipulation of human behavior. New York: Wiley, 1961.

3. Edwards, A.L. The relationship between the judged desirability of a trait and the probability that the trait will be endorsed. J. App. Psy. 1953, 37, 90-93.

4. Edwards, A.L. The social desirability variable in personality assessment and research. New York: The Dryden Press, 1957.

5. Ellson, D.C., Burke C.G., Davis R.C., & Saltzman, I.J., A report of research on detection of deception. Contract N6onr - 18011 with Office of Naval Research, 1952

6. Gustafson, L.A. & Orne, M.T. Effects of heightened motivation on the detection of deception. J. App. Psychol., 1963, 47, 408-411.

7. Gustafson, L.A. & Orne, M.T. The effects of verbal responses on the laboratory detection of deception. Psychophysiology 1965, 2

8. Guttman, L. A basis for scaling quantitative data. Amer. Socio. Rev. 1944, 9, 139 -150

9. Guttman, L. A structural theory for intergroup beliefs and action. Amer. Soc. Rev. 1959, V 24 318 -328

10. Guttman, L. in: S.A. Stouffer et al. (ed) The American Soldier. Princeton, New-Jersey: Princeton University Press, 1949.

11. Guttman, L. The quantification of a class of attitudes: a theory and method of scale construction. In: P. Horvst (Ed.), The prediction of personal adjustment. New York: Social Science Research Council, Bull. No. 48, 1941.

12. Hearings before the Subcommittee of the Committee on Federal Government Operations, on the Use of Polygraphs as "Lie Detectors" by the Federal Government, Part 3, Panel Discussion with Scientists. Government Publications Office, Washington D.C., 1964.

13. Inbau, F.E. Lie detection and criminal interrogation, (2nd ed.) Baltimore: Williams & Wilkens, 1948.

14. Inbau, F.E. & Reid, J.E. Lie detection and criminal interrogation Baltimore, Williams & Wilkens, 1953.

15. Johnson, L.C. & Corah, N.L. Racial differences in skin resistance. Science, 1963, 139, 766 - 767.

16. Johnson, L.C. & Landon, M.M. Eccrine sweat gland activity and racial differences in restine skin conductance. Psychophysiology, 1965, 1, 322 - 329.

17. Kugelmass, S. Air Force EOAR Grant 63 - 61, 1963.

18. Kugelmass, S. & Lieblich, I. Effects of realistic stress and procedural interference in experimental lie detection. J. App. Psy. 1966, 50, 211 - 216.

19. Kubis, J.F. Studies in lie detection computer feasibility considerations. RADC - TR 62 - 205, 1962

20. Lacey, J.I. Psychophysiological approaches to the evaluation of psychotherapeutic process and outcome. In: A. Rubinstein & M.B. Perloff (Eds.) Research in psychotherapy. Washington D.C., 1958.

21. Lykken, D.T. The GSR in the detection of guilt. J. App. Psy., 1959, 43, pp. 385 - 388.

22. Mackay, D.M. The informational analysis of questions and commands. In: Colin Cherry (Ed) Information theory. London, Butterworth, 1961.

23. Malmo, R.B. Activation: A neuropsychological dimension. Psychol. Rev. 1959, 66, 367 - 386.

24. Maltzman, 1. & Raskin, D.C. Effects of the orienting reflects on conditioning and complex processes. J. exp. Res. Pers. 1965, 1, 1 - 16.

25. Sarason, I.G. Expirical findings and theoretical problems in the use of anxiety scales. Psychol. Bull., 1960, 57, 403 - 415.

26. Sternbach, R.A. & Tursky, B. Ethnic differences among housewives in psychophysiological and skin potential responses to electric shock. Psychophysiol. 1964, 1, 241 - 246.

27. Vandenberg S.G., Clark P.J., and Samuels, I., Psychophysiological reactions of twins: Heritability estimates of galvanic skin resistance, heart beat and breathing rate. Psychphysiol. (In press).

28. Violante, R. & Ross, S.A. Research on interrogation procedures. Contract Nonr 4129 (00) 1964

29. Wilden, J. Modern psychophysiology and the law of initial values. Amer. J. Psychotherapy, 1958, 12, 199.

30. Woodworth, R.S. & Schlosberg, H. J. Exp. Psychol. New York: Holt & Comp., 1956.

31. Yankee, W.S. An investigation of sphygmomanometer discomfort thresholds in polygraph examinations. Police 1965, July - August, 12 - 18.

The following are publications based on some of the data presented in this report.

1. Kugelmass, S. and Lieblich, I. Some correlates of orienting response indices in experimental lie detection. Proceedings of the 18th International Conference of Psychology, Moscow: Page 186. 1966.

2. Kugelmass, S. and Lieblich, I. The effects of realistic stress and procedural interference in experimental lie detection. J. App. Psy., 1966, 50, 211 - 216.

3. Kugelmass, S., Lieblich, I. and Bergmen, Z. The role of "lying" in psychophysiological detection. Psychophysiology, 1967 (in press).

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

The Hebrew University
Department of Psychology
Jerusalem, Israel

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

REACTIONS TO STRESS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific Final

5. AUTHOR(S) (First name, middle initial, last name)

Sol Kugelmass

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
1 January 1967	90	31

8a. CONTRACT OR GRANT NO.

AF61(052)-839

b. PROJECT NO.

c. 61445014

d. 681313

9a. ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

AFOSR 67-0530

10. DISTRIBUTION STATEMENT

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

AF Office of Scientific Research (SRLB)
1400 Wilson Boulevard
Arlington, Virginia 22209

13. ABSTRACT

This report on a series of experiments involves the following research:

(1) The Influence of Blood Pressure Cuff Application on the Efficiency of GSR Detection.
(2) Examination of Certain Biographical Correlates of GSR Reactivity During Experimental Lie Detection.
(3) Experimental Evaluation of GSR and Blood Pressure Change Indices During Criminal Interrogation.
(4) The Role of "Lying" in Psychophysiological Detection.
(5) The Effect of Variation in the Mode of Stimulus Presentation on Differential GSR Reactivity.
(6) Identification of Variables Related to the Efficiency of the Detection of Information Within the Organism, using a Physiological Index.

DD FORM 1 NOV 65 1473

UNCLASSIFIED
Security Classification